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EXAMINER	
BOOKER, VICKI B	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/596,726	Applicant(s) YANSON ET AL.	
	Examiner VICKI B. BOOKER	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _03 February 2010_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1 - 29, 37_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1 - 29, 37_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _03 February 2010_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _03 February 2010_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the amendment filed February 3, 2010. Currently, **Claims 1 – 29** and **37** are pending.

Response to Arguments

Applicant's arguments with respect to **Claims 1 – 29** and **37** have been considered but are moot in view of the new ground(s) of rejection. **Applicant's amendment necessitates the new ground(s) of rejection as noted below.**

Specification

The substitute specification filed February 3, 2010 ***has been entered***.

Drawings

Applicant's amendment of the drawings has been reviewed and is **acceptable**. ***Examiner therefore withdraws objections to the drawings and enters the amendment filed February 3, 2010***.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, **2**, **7 – 9**, **11**, **15**, **21**, and **37;** and **Claims 3**, **12**, **16**, **18 – 20**, **22 – 24**, and **29** are rejected under 35 U.S.C. 103(a) as being unpatentable over Teng et al. (WO 03/085742; published 10/16/2003; hereinafter "TENG '742") in view of Kimura et al. (US 5,739,552; dated 04/14/1998; hereinafter "KIMURA").

Regarding **Claim 1** and **Claim 37**, TENG '742 ***teach or disclose*** a method for producing multiple quantum well intermixed (QWI) regions having different bandgaps on a single substrate ("Method for Forming A Modified Semiconductor Having A Plurality of Band Gaps"; See Abstract), comprising the steps of:

> forming a substrate 1 comprising one or more core layers defining at least one quantum well 4 (See, for example, "Third Preferred Embodiment" shown as a flowchart in FIG. 4 and FIG. 6A – FIG. 6H; Page 12, line 15 through Page 14, line 4; **Claim 1**; **Claim 37**);
>
> depositing a succession of intermixing barrier layers 8, 9 over the quantum well 4 in a continuous process sequence (See FIG. 1 and FIG. 4, which teaches process sequences that are continuous, iterative processes; a continuous process sequence is thereby taught or disclosed as claimed) each successive intermixing barrier layer 8, 9 being formed of a semiconductor material (Page 3, line 29 through Page 4, line 5; "low temperature deposited InP" or "low temperature deposited InGaAs or GaAs") and having a different etch characteristic than an immediately preceding barrier layer (**Claim 1**; Examiner notes an etch characteristic is an inherent physical property of a material; Therefore the different

materials 9, 10 shown in FIG. 6A - FIG. 6H inherently have different etch characteristics);

or

depositing a succession of intermixing barrier layers 8, 9 across substantially the entire width of the substrate, (See FIG. 1 and FIG. 4, which teaches process sequences that are continuous, iterative processes; a continuous process sequence is thereby taught or disclosed as claimed) each successive intermixing barrier layer 8, 9 being formed of a semiconductor material (Page 3, line 29 through Page 4, line 5; “low temperature deposited InP” or “low temperature deposited InGaAs or GaAs”) and having a different etch characteristic than an immediately preceding barrier layer (**Claim 37**; Examiner notes an etch characteristic is an inherent physical property of a material; Therefore the different materials 9, 10 shown in FIG. 6A - FIG. 6H inherently have different etch characteristics);

etching away (Page 4, line 13 – 14; “photolithography"; Fig. 4, Step 6; “patterning layer”) different numbers of the successive barrier layers 8, 9 in different regions F, G of the substrate 1 (FIG. 6A – FIG. 6H; Page 12, line 15 – Page 14, line 4) so as to provide different total thicknesses of barrier layer in different regions F, G of the substrate 1 (**Claim 1**; **Claim 37**); and

applying an intermixing agent ("annealing"; FIG. 4, Step 7; Page 13, line 27 – 31) to the surface of the substrate 1 such that the degree of intermixing in the quantum well region varies as a function of the total thickness of barrier layer, thereby forming different bandgaps in the quantum well in each of the respective regions (**Claim 1**; **Claim 37**; "thermally annealing 7 the heterostructure to cause intermixing in the quantum region thereby producing a semiconductor heterostructure with a surface having particular regions which exhibit different band gap shifts depending on which combination of materials they were covered by"; Page 13, line 27 – 31).

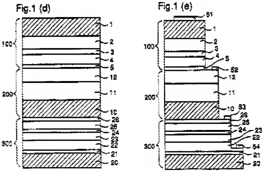
TENG '742 ***does not teach or disclose further wherein the step of etching away different numbers of the successive barrier layers <u>is performed after</u> deposition of the succession of intermixing barrier layers***.

Regarding this limitation, Examiner notes TENG teaches another embodiment shown in FIG. 1 ("First Embodiment"; Column 5, line 54 – Column 6, line 14). In this First Embodiment, a succession of intermixing barrier layers are deposited (FIG. 1, label 5), but are not etched.

TENG '742 teaches the wavelengths exhibited by the quantum well in the substrate can be accurately manipulated by varying the coverage ratios of the different succession intermixing barrier layers formed on the substrate (Column 9, line 45 – 48). These coverage ratios serve as a way to tune or form multiple band gaps in a singles

substrate. See Column 9, line 34 - 48 and FIG. 9. TENG thereby teaches the coverage ratios of the intermixing barrier layers are ***results-effective variables*** used to form a plurality of band gaps in a semiconductor substrate, as desired by design choice (See MPEP § 2144.05 Section II.B).

TENG '742 teaches forming the step-like structure over the semiconductor substrate in a deposit-pattern-etch iterative fashion (FIG. 4 embodiment). However, KIMURA teaches a technique of forming a step-like structure over a substrate 20 by first forming a succession of layers on the substrate and then using ordinary photo-lithographic and etching techniques to pattern the succession of layers to achieve a step-like structure, as desired by design choice. See Column 8, line 31 - 38 and FIG. 1(d) - FIG. 1(e):



It would have been obvious for one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 1** and **Claim 37**, by applying the method of TENG '742 as noted in the Embodiment of FIG. 1 and forming a succession of intermixing barrier layers and then etching away different numbers of the

barrier layers in different regions to pattern a step-like structure over the substrate using ordinary photo-lithographic and etching techniques as taught by KIMURA, to produce multiple quantum well intermixed regions having different bandgaps on a single substrate, and thereby by forming a desired coverage ratio as taught by TENG '742, since it has been held that optimization of a results-effective variable – which in the instant case is optimization of the coverage ratio of the barrier layers – is prima facie obvious for one of ordinary skill in the art (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)). A prima facie case of obviousness thereby exists for **Claim 1** and **Claim 37** (MPEP § 2142).

Regarding **Claim 2**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** in which the step of depositing the intermixing barrier layers 8, 9 comprises epitaxial growth (TENG '742; "molecular beam epitaxy (MBE)"; Page 4, line 7; Page 10, line 20).

Regarding **Claim 7** and **Claim 8,** TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** further including the step of activating the intermixing agent (TENG '742; "annealing causes intermixing"; Page 10, line 27; **Claim 7**) and further wherein the step of activating the intermixing agent comprises thermally processing the substrate after delivering the intermixing agent to the substrate (TENG '742; Fig. 4, Step 7, "Annealing"; Page 13, line 27 – 31; "thermally annealing 7 the heterostructure to cause intermixing in the quantum region"; **Claim 8**).

Regarding **Claim 9**, TENG ‘742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** in which the barrier layers 8, 9 alternate between two different material types (TENG ‘742; Page 10, line 8 – 10).

Regarding **Claim 11** and **Claim 15**, TENG ‘742 in view of KIMURA ***teach or disclose*** the method of **Claim 1**, respectively, in which the quantum well region 4 is formed from an aluminium quaternary indium phosphide material (TENG ‘742; “InGaAlAs”; Page 6, line 3; **Claim 11**) or an aluminium ternary gallium arsenide material (TENG ‘742; “AlGaAs”; Page 6, line 1; **Claim 15**).

Regarding **Claim 21**, TENG ‘742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** in which the step of depositing the succession of intermixing barrier layers comprises:

> depositing a first intermixing barrier layer 8 onto the substrate 1 over said quantum well region 4, the first barrier layer 8 being formed of a semiconductor material (TENG ‘742Page 10, line 1 – 10) having a first etch characteristic (TENG ‘742; FIG. 6A; Examiner notes an etch characteristic is an inherent material property);
>
> depositing a second intermixing barrier layer 9 onto the substrate 1 over said first barrier layer 8, the second barrier layer 9 being formed of a

semiconductor material (TENG '742; Page 10, line 1 – 10) having a second etch characteristic (TENG '742; FIG. 6E); and

etching away the first 8 and second 9 barrier layers in first regions F of the substrate 1 (TENG '742; FIG. 6E – FIG. 6F) and etching away the second barrier layer 9 in second regions G of the substrate 1 (TENG '742; FIG. 6F) and leaving the first and second barrier layers 8, 9 in other regions J of the substrate 1 (TENG '742; FIG. 6G);

such that after applying the intermixing agent (TENG '742; "annealing"; FIG. 4, Step 7) to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in each of the first regions F, the second regions G and the other regions J (TENG '742; Page 13, line 27 – Page 14, line 4).

Regarding **Claims 3**, **12**, **16**, and **24**; and **Claims 22 – 23**; TENG '742 in view of KIMURA ***teach or disclose*** the method of ***<u>Claim 1</u>*** and ***<u>Claim 21</u>***, respectively, as noted above.

Regarding the further limitations for <u>Claim 1</u> in which

the intermixing barrier layers each comprise substantially single crystal semiconductor layers (**Claim 3**);

or in which

the intermixing barrier layers include successive layers of indium phosphide (InP) and indium gallium arsenide (InGaAs) (**Claim 12**);

or in which

the intermixing barrier layers include successive layers of gallium arsenide (GaAs), aluminium gallium arsenide (AlGaAs) or aluminium arsenide (AlAs) (**Claim 16**) –

or in which

the step of depositing the succession of intermixing barrier layers comprises:

depositing a first and second intermixing barrier layers onto the substrate over said quantum well region, the first and second barrier layers being formed of semiconductor material and respectively having first and second etch characteristics;

depositing a third and fourth intermixing barrier layers onto the substrate over said first and second barrier layers, the third and fourth barrier layers being formed of semiconductor material and respectively having third and fourth etch characteristics;

etching away the first, second, third and fourth barrier layers in first regions of the substrate and etching away the third and fourth barrier layers in second regions of the

substrate and leaving the first, second, third and fourth barrier layers in other regions of the substrate;

such that after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in the first regions, the second regions and the other regions (**Claim 24**);

and regarding the further limitations for <u>Claim 21</u> in which

the step of depositing further includes

depositing a third intermixing barrier layer onto the substrate prior to depositing the first and second barrier layers, the third barrier layer being formed of a semiconductor material having a third etch characteristic; and

in which the etching step includes etching away the first, second and third barrier layers in third regions of the substrate; such that after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in each of the first regions, the second regions, the third regions and the other regions (**Claim 22**); ***and still further in which***

the third etch characteristic is the same as the second etch characteristic (**Claim 23**) –

Examiner notes the following teachings of TENG '742:

TENG '742 teaches a large variety of band gap shifts can be achieved ***in different regions of the same substrate*** by combining two, three, four, or more layers of different materials in succession and applying them in different coverage ratios by patterning the layers in different ways on the substrate and over the quantum well region of the substrate (Page 14, lines 5 – 10; See also Abstract).

TENG '742 teach the patterning of the intermixing barrier layers can be by photolithography (Page 4, line 14) – which Examiner notes is a patterning technique that comprises etching (MPEP § 2144.03).

TENG '742 provides some specific examples in FIG. 7 – FIG. 10 of the different band gap shifts that can be achieved using different materials, different annealing processes, and different pattern coverage ratios.

TENG '742 thereby teaches the number of intermixing barrier layers formed on the surface of the substrate; the choice of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate surface; are ***results-effective variables*** used to achieve different bandgaps in different regions of the same substrate (MPEP § 2144.05 Section II. B.)

Therefore, it would have been obvious for one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claims 3**, **12**, **16**, and **22 – 24**, based on the teachings of TENG '742 as noted above.

The motivation for doing so would have been to optimize the number of intermixing barrier layers formed on the surface of the substrate; the type of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate – ***through routine experimentation*** – such that, after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in the first regions, the second regions and the other regions of the substrate – **as desired by design choice** (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

A prima facie case of obviousness thereby exists for **Claims 3**, **12**, **16**, and **22 – 24 (MPEP § 2142).**

Regarding **Claim 18,** TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** as noted above. ***Regarding the limitation of*** further comprising the step of planarizing the substrate after the applying the intermixing agent, Examiner will interpret "planarizing the substrate" as removing all or part of a layer -- based on the use of "planarizing" in the specification as noted for FIG. 1-9 – FIG. 1-12 and described on Page 10, lines 1 – 13 of the specification.

TENG '742 teaches planarizing the substrate 1 after applying the intermixing agent 8 (FIG. 6A - FIG. 6B).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claim 18**, based on the teachings of TENG '742.

The motivation for doing so, at the time of the invention, would have been to pattern the surface of the substrate, as desired, to form multiple quantum well intermixed regions having different bandgaps on a single substrate, as taught by TENG '742 (Page 14, line 5 – 10). A prima facie case of obviousness thereby exists for **Claim 18** (See MPEP § 2142).

Regarding **Claim 29**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 18** as noted above. ***Regarding the further limitation of still further including the steps of:***

> depositing a succession of planarization layers beneath the succession of intermixing barrier layers, the succession of planarization layers identical in number of layers and layer materials to the first succession of barrier layers, but having a total thickness substantially less than the total thickness of the first succession of intermixing barrier layers;
>
> planarizing the substrate by successively removing intermixing barrier layers and corresponding planarization layers in a series of selective etches –

Examiner notes the following teachings of TENG '742:

TENG '742 teaches a large variety of band gap shifts can be achieved by combining two, three, four, or more layers of different materials in succession and applying them in different coverage ratios by patterning the layers in different ways on the substrate and over the quantum well region (Page 14, lines 5 – 10).

TENG '742 teaches the patterning of the intermixing barrier layers can be by photolithography (Page 4, line 14) – which Examiner notes is a patterning technique that comprises etching (MPEP § 2144.03).

TENG '742 provides some specific examples in FIG. 7 – FIG. 10 of the different band gap shifts that can be achieved using different materials, different annealing processes, and different pattern coverage ratios.

Therefore, TENG '742 teaches the number of intermixing barrier layers formed on the surface of the substrate; the choice of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate surface; are ***results-effective variables*** used to achieve different bandgaps in different regions of the same substrate (MPEP § 2144.05 Section II. B.)

Therefore, it would have been obvious for one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claim 29** based on the teachings of TENG '742 as noted above.

The motivation for doing so would have been to optimize the number of intermixing barrier layers formed on the surface of the substrate; the type of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate – ***through routine experimentation*** – such that, after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in the first regions, the second regions and the other regions of the substrate – **as desired by**

design choice (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)). A prima facie case of obviousness thereby exists for **Claim 29** (MPEP § 2142).

Regarding **Claim 19**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 18** as noted above, in which the planarizing step comprises removing one or more of the intermixing barrier layers from the surface of the substrate (TENG '742; FIG. 6A – FIG. 6B).

Regarding **Claim 20**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 19** as noted above, in which the planarizing step comprises removing all of the intermixing barrier layers from the surface of the substrate (Since TENG '742 teach the pattern of the intermixing barrier layers is a results-effective variable, effecting the value of the band-gap shift in the substrate – See TENG '742 teachings as noted for **Claim 29** above – removing all of the intermixing barrier layers from the surface of the substrate would be a matter of design choice in order to pattern the surface of the substrate, as desired, to achieve a desired band gap shift in the substrate; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Claims 5, **6**, **10**, **25**, and **28** are rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of KIMURA, further in view of Applicant's Admitted Prior Art (hereinafter "APA").

Examiner notes subsequent reference to APA is made using Applicant's specification as published (US 2007/0246701 A1; published 10/25/2007). See MPEP § 2129 Section I and II.

Regarding **Claim 5**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 1** in which the step of applying an intermixing agent to the surface of the substrate comprises bombarding the substrate with high energy ions in an ion implantation process (APA, Para [0011] teaches it is commonly known in the art to use ions as an intermixing agent by directing an ion beam at the material being intermixed; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 6**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 1** in which the step of applying an intermixing agent to the surface of the substrate comprises depositing a QWI cap layer onto the substrate, the QWI cap layer initiating or promoting intermixing (APA Para [0011] teaches it is commonly known in the art to apply an intermixing agent in the form of a QWI cap layer ("dielectric cap") to initiate or promote intermixing; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 10**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 1** in which the barrier layers are grouped in pairs, each of the respective regions having a different number of pairs of barrier layers

(APA teaches it is commonly known in the art to use the thickness of a barrier layer to control the rate of intermixing; The barrier layer thickness is thereby a results-effective variable; See Para [0011]; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 25**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 6** in which the QWI cap layer comprises an impurity rich material (APA, Para [0011], “intermixing agent may be in the form of a dielectric cap containing an impurity source”; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 28**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 6** in which the QWI cap layer is sputter deposited (Examiner notes sputter-depositing a layer is commonly known in the art as an effective means to deposit a layer; MPEP § 2144.03; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG ‘742 in view KIMURA, further in view of Fu et al. (US 2004/0038503; published 02/26/2004; hereinafter “FU”).

Regarding **Claim 4**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 1** as noted above.

TENG '742 in view of KIMURA ***do not disclose further*** in which the steps of forming the substrate ***and*** depositing the succession of intermixing barrier layers in a continuous process sequence are carried without removal of the substrate from the vacuum deposition environment.

Examiner notes TENG ‘742 teaches depositing the intermixing barrier layers in epitaxial growth equipment (“MBE”; Page 10, line 20) and that the substrate 1 is a heterostructure substrate (Page 8, line 16 – 21; Page 12, line 25 – 27).

FU teach a heterostructure substrate can be formed in epitaxial growth equipment ("MBE”; Paragraph [0002]).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG ‘742 in view of KIMURA to obtain the invention of **Claim 4** based on the teachings of FU.

The motivation for doing so, at the time of the invention, would have been an obvious matter of equipment cost savings by carrying out the step of forming the substrate and the step so depositing the intermixing barrier layers in the same epitaxial growth equipment without removal of the substrate from the vacuum deposition environment since FU teaches MBE can be used to form a heterostructure substrate, and TENG '742 teaches use of MBE to form the intermixing barrier layers. A prima facie case of obviousness thereby exists for **Claim 4** (MPEP § 2142).

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG ‘742 in view of KIMURA, further in view of Pommereau et al. (US 6,309,904; dated

10/30/2001; hereinafter "POMMEREAU") and still further in view of Kinoshita et al. (US 5,021,361; dated 06/04/1991; hereinafter "KINOSHITA").

Regarding **Claim 13**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 12** as noted above. ***Regarding the further* limitation *in which said step of etching away comprises etching the InGaAs layers in H_3PO_4:H_2O_2:H_2O and etching the InP layers in HCl:H_2O –***

POMMEREAU teaches H_3PO_4:H_2O_2:H_2O as suitable for etching InGaAs layers (Column 6, line 59 – 61).

KINOSHITA teaches HCl:H_2O ("hydrochloric acid solution"; Column 7, line 67 – 68) as suitable for etching InP layers.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claim 13**, based on the teachings of POMMEREAU and KINOSHITA, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the InGaAs layers and the InP layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416). A prima facie case of obviousness thereby exists for **Claim 13** (See MPEP § 2142).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of KIMURA, further in view of POMMEREAU, and still further in view of Cheng et al. (US 4,829,347; dated 05/9/1989; hereinafter "CHENG").

Regarding **Claim 14**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 12** as noted above. ***Regarding the further* limitation *in which the etching step comprises etching the InGaAs layers in H_2SO_4:H_2O_2:H_2O and etching the InP layers in HCl:H_3PO_4 –***

POMMEREAU teaches H_2SO_4:H_2O_2:H_2O as suitable for etching InGaAs layers (Column 6, line 59 – 62).

CHENG teaches HCl:H_3PO_4 as suitable for etching InP layers (Column 6, line 57 – 58).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claim 14**, based on the teachings of POMMEREAU and CHENG, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the InGaAs layers and the InP layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416). A prima facie case of obviousness thereby exists for **Claim 14** (See MPEP § 2142).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of KIMURA, further in view of Bayraktaroglu (US 5,283,448; dated 02/01/1994; hereinafter "BAYRAKTAROGLU") and still further in view of Kasahara et al. (US 5,527,732; dated 06/18/1996; hereinafter "KASAHARA").

Regarding **Claim 17**, TENG '742 in view of KIMURA ***teach or disclose*** the method of **Claim 16** as noted above. ***Regarding the further limitation in which said step of etching away comprises etching the GaAs layers in H_2SO_4:H_2O_2:H_2O and etching the AlGaAs/AlAs layers in a buffered HF solution –***

BAYRAKTAROGLU teaches H_2SO_4:H_2O_2:H_2O as suitable for etching GaAs layers (Column 2, line 22 – 23).

KASAHARA teaches a buffered HF solution as suitable for etching AlGaAs/AlAs layers (Column 6, line 54 – 57; FIG. 3).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA to obtain the invention of **Claim 17**, based on the teachings of BAYRAKTAROGLU and KASAHARA, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the GaAs layers and the AlGaAs/AlAs layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416). A prima facie case of obviousness thereby exists for **Claim 17** (See MPEP § 2142).

Claims 26 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of KIMURA; further in view of APA; and still further in view of Thornton et al. (US 4,875,216; dated 10/17/1989; hereinafter "THORNTON").

Regarding **Claim 26** and **Claim 27**, TENG '742 in view of KIMURA, further in view of APA ***teach or disclose*** the method of **Claim 25** as noted above.

Regarding the further limitation in which

the impurity comprises one or more of sulphur, zinc, silicon, fluorine, copper, germanium, tin and selenium (Claim 26);

or in which, for the method of Claim 25 or Claim 26,

the impurity-rich material comprises silica doped with one or more of the impurities sulphur, zinc, silicon, fluorine, copper, germanium, tin and selenium –

Examiner notes the following teachings of THORNTON:

THORNTON teaches a QWI cap layer initiating or promoting intermixing ("impurity induced disordering (IID)") that comprises impurities such as silicon, zinc, tin, germanium, sulfur, or other impurity species (Column 5, line 17 – 19).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of KIMURA, further in view of APA to obtain the invention of **Claim 26** and **Claim 27**, based on the teachings of THORNTON.

The motivation for doing so, at the time of the invention, would have been to select suitable impurity species for the QWI cap layer, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable impurity species for the QWI cap layer, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416). A prima facie case of obviousness thereby exists for **Claim 26** and **Claim 27** (MPEP § 2142).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vicki B. Booker whose telephone number is 571-270-1565. The examiner can normally be reached Monday through Thursday 8:00am to 4pm E.S.T. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew C. Landau can be reached on 571-272-1731. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Vicki B. Booker/
Examiner, Art Unit 2813

/Matthew C. Landau/
Supervisory Patent Examiner, Art Unit 2813